

NEWTON's TELECOM DICTIONARY

24th Edition

Harry Newton



New York

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Stay In Touch

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I promise you I won't give your name to anybody. Nobody. Promise.

Harry Newton
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Class B Certification A Federal Communications Commission (FCC) certification that a given make and model of computer meets the FCC's Class B limits for radio frequency emissions, which are designed to protect radio and television reception to residential neighborhoods from excessive radio frequency interference (RFI) generated by computer usage. Class B computers also are shielded more efficiently from external interference. Computers used at home are more likely to be surrounded by radio and television equipment. If you plan to use your computer at home, avoid computers that have only Class A certification (that is, they failed Class B).

Class B Networks See Internet Address.

Class B Traffic A class of ATM (Asynchronous Transfer Mode) traffic defined by the ITU-T. Class B traffic is defined as being connection-oriented, Real-Time Variable Bit Rate (rt-VBR) traffic that must be carefully synchronized between transmitter and receiver. Further, such traffic is stream-oriented, and can tolerate some levels of both latency (i.e., delay) and jitter (i.e., variability in latency). Class B traffic is supported by AAL (ATM Adaptation Layer) Type 2. Examples of Class B traffic include compressed voice and video. See also AAL 2.

Class C Networks See Internet Address.

Class C Traffic A class of ATM (Asynchronous Transfer Mode) traffic defined by the ITU-T. Class C traffic is defined as being connection-oriented, Non Real-Time Variable Bit Rate (nrt-VBR) traffic that requires no synchronization between transmitter and receiver. Class C traffic can tolerate considerable levels of both latency (i.e., delay) and jitter (i.e., variability in latency). Class C traffic is supported by AAL (ATM Adaptation Layer) Type 3/4. Examples of Class C traffic include X.25 and Frame Relay. See also AAL 3/4.

Class C IP block. A class C is a block of 256 IP address - 254 usable (0 is reserved for a broadcast for the subnet and 255 is for a loopback.)

Class D Traffic A class of ATM (Asynchronous Transfer Mode) traffic defined by the ITU-T. Class D traffic is defined as being connectionless, Non Real-Time Variable Bit Rate (nrt-VBR) traffic that requires no synchronization between transmitter and receiver. Class D traffic can tolerate considerable levels of both latency (i.e., delay) and jitter (i.e., variability in latency). Class D traffic is supported by AAL (ATM Adaptation Layer) Type 3/4. Examples of Class D traffic include LAN and SMDS. See also AAL 3/4. See Internet Address.

Class E Networks See Internet Address.

Class n Office The way a telephone company defines its switching facilities. Class 5 is an end office (local exchange), Class 4 is a toll center, Class 3 is a primary switching center, Class 2 is a sectional switching center, and Class 1 is a regional switching center. See Class 1, Class 2, Class 3, Class 4 and Class 5.

class of emission The set of characteristics of an emission, designated by standard symbols, e.g., type of modulation of the main carrier, modulating signal, type of information to be transmitted, and also if appropriate, any additional signal characteristics.

class of office A ranking assigned to switching points in the telephone network, determined by function, interfaces and transmission needs.

class of service 1. Here's the definition of Class of Service internal to a PBX: Each phone in a corporation telephone system may have a different collection of privileges and features assigned to it, such as access to long distance, international calls, 900 area code calls, 976 local calls, etc. Let's say you are afraid that your people will waste the company's money by frivolously calling some expensive numbers, you might wish to define "Class of Service" assignments in your PBX. You could have one that's called "ability to dial everywhere except 900 area code, international calls and all 976 numbers." That could be Class of Service Assignment B. When you give a phone to an employee, you could simply give that person COS B. Big bosses, on the other hand might need to call internationally, but not 900 area code or 976 calls. That could be called Class of Service Assignment A. Class of Service assignments if properly organized, can become an important tool in controlling telephone abuse.

2. Here's the definition on the public switched network: A subgrouping of telephone users for the sake of rate distinction. This may distinguish between individual and party lines, between Government lines and others, between those permitted to make unrestricted international dialed calls and others, between business or residence and coin, between flat rate and message rate, and between restricted and extended area service.

3. Here are words courtesy Cisco relating to class of service issues on a packet switched network. "Networks typically operate on a best-effort delivery basis. All traffic has equal priority and an equal chance of being delivered in a timely manner. When congestion occurs, all traffic has an equal chance of being dropped. However, network managers are increasingly presented with a variety of bandwidth-hungry applications that compete for limited bandwidth on the enterprise network. These applications have a variety of characteristics. They may be mission-critical legacy applications with a Web interface, online business-critical applications, or newer multimedia-based applications such as desktop videoconferencing,

Web-based training, and voice (telephone) over IP. Some of these applications are vital to core business processes, while many are not. It is the network manager's job to ensure that mission-critical application traffic is protected from other bandwidth-hungry applications; while still enabling less critical applications such as desktop videoconferencing. Enterprises that want to deploy new bandwidth-hungry applications are judging that it is paramount to also ensure the continued success of mission-critical applications over both the LAN and WAN. This can be achieved by defining network policies, which align network resources with business objectives and are enforced by means of QoS (Quality of Service) mechanisms. Without these QoS controls, non-vital applications can quickly exhaust network resources at the expense of more important ones, such as mission-critical applications, thus compromising business processes and certainly productivity. The QoS feature on the Cisco Catalyst 6000 family of switches prioritizes network traffic with IEEE 802.1p class-of-service (CoS) values that allow network devices to recognize and deliver high-priority traffic in a predictable manner. When congestion occurs, QoS drops low-priority traffic to allow delivery of high-priority traffic. Ports can be configured as trusted or untrusted, indicating whether or not to trust the CoS values in received frames to be consistent with network policy. On trusted ports, QoS uses received CoS values. On untrusted ports, QoS replaces received CoS values with the port CoS value."

Class X Traffic A class of ATM (Asynchronous Transfer Mode) traffic defined by the ITU-T. Class X traffic is defined as being either connection-oriented or connectionless, traffic that accepts either Unspecified Bit Rate (UBR) or Available Bit Rate (ABR) transmission, and that requires no synchronization between transmitter and receiver. Class X traffic can tolerate considerable levels of both latency (i.e., delay) and jitter (i.e., variability in latency). Class X traffic is supported by AAL (ATM Adaptation Layer) Type 5. Examples of Class X traffic include LANE (LAN Emulation) and IP. See also AAL 5.

Class-4 Switch Class-4 is a type of circuit switch used in a tandem office. In the past, Class-4 switches managed only high-speed, four-wire T-1, T-3, and OC-3 connections (used to deliver long-distance services) in contrast to two-wire local lines on Class-5 switches. All switches now support four-wire lines.

Class-5 Switch Class-5 is a type of circuit switch used in a local telephone end office. It provides end-customer services, such as call waiting and call forwarding.

Classical IP A set of specifications developed by the Internet Engineering Task Force (IETF) for the operation of LAN-to-LAN IP connectivity over an ATM network.

classified ad Log Records required by Section 76.221(f) of the FCC Rules which relate to origination cablecasts or classified advertisements sponsored by individuals. This rule provides that the sponsor of such programming need not be identified within the content of the advertisement or program itself provided that two conditions are met:

- The true sponsor must be an individual offering services which he or she personally provides (examples: yard work; babysitting).
- The system must maintain a written record of the name, address, and telephone number of the individual.

classified heading A heading in the yellow pages that describes a type of business or service, and under which businesses of that type have their directory listings and advertising.

classified section guide A special section of the yellow pages that includes specialty headings and in which businesses may purchase advertising and special listings. For example, there may be a Physicians and Surgeons Guide, an Attorneys Guide, and a Restaurants Guide. Each of these section guides contains specialty headings not found in the regular classified headings. For example, in the Attorneys Guide, the specialty headings may include Animal Protection Law, Appellate Practice, Automobile Accidents & Injuries, Aviation Law, Bankruptcy Law, Business Law, Civil Litigation, Condominium Law, Construction Law, Maritime Law, and other specialties. A classified section guide typically is filled with ads, many of which may be full-page and two-page ads.

Classless Inter-Domain Routing See CIDR.

classmark A designator used to describe the service feature privileges, restrictions, and circuit characteristics for lines or trunks accessing a switch; e.g., precedence level, conference privilege, security level, zone restriction. See Class of Service.

CLAW Common Link Access for Workstations. Data link layer protocol used by channel-attached RISC System/6000 series systems and by IBM 3172 devices running TCP/IP off-load. CLAW improves the efficiency of channel use and allows the Channel Interface Processor (CIP) to provide the functionality of a 3172 in TCP/IP environments and to support direct channel attachment. The output from TCP/IP mainframe processing is a series of IP datagrams that the router can switch without modifications. See CIP.

CLC Carrier Liaison Committee. A committee formed to help industry participants work together to resolve the issues of implementing 800 Portability. CLC is sponsored by the Ex-

QoR Query on Release. See LNP (Local Number Portability).

QoS Quality of Service. See Class of Service and Quality of Service.

QAM Quadrature Phase Amplitude Modulation. Used in high speed modems to send multiple data bits per baud. This type of modulation views the electrical signal as a vector that can be placed, by combining the signals of two amplitude modulators that are 90 degrees out of phase, on a matrix of targets (sometimes called an eye-pattern) representing numeric values. The number of bits / baud determines the number of targets that are required. It is used in a wide variety of modems from voice frequency up to microwave baseband (100 MHz - 800 Mhz).

QPSK Quaternary Phase Shift Keying. A compression technique used in modems and in wireless networks, such as CDMA (Code Division Multiple Access) and 802.11a. A simple implementation of QPSK allows the transmission of 2 bits per symbol, with each symbol being a phase range of the sine wave. In this fashion, a 2:1 compression ratio is achieved, resulting in a doubling of the efficiency with which a circuit is employed. For instance, 0-90 degrees of phase indicates a 11 bit pattern; 90-180 degrees a 01; 180-270 a 10; and 270-360 a 00. In wireless networks, two carrier signals can be used, each of which is separated by 90 degrees of phase (position). If the phase of the carrier signals were not separated, one would be indistinguishable from the other. A 90-degree phase shift provides maximum phase separation and, therefore, maximum delineation between the carrier signals. See also 802.11a and CDMA.

QPSX Queued Packet Synchronous Exchange. Medium Access Control technology developed by the University of Western Australia for use in extending the reach of LANs across a Metropolitan Area Network (MAN). The technology was licensed to QPSX, Ltd. and subsequently was standardized by the IEEE as 802.6. QPSX was commercialized by Bellcore as QDDB, which is the access technology for SMDS networks. See also QDDB and SMDS.

QR Connector See XLR connector.

QRSS Quasi-Random Sequence Signals or Quasi-Random Signal Source. An industry-standard test pattern employing a fixed bit sequence to simulate random data and used to Signals used for testing digital circuits, in particular DS-1 (i.e. T-1) circuits.

QAM Quadrature Sideband Amplitude Modulation. A sophisticated modulation technique, using variations in signal amplitude, that allows data-encoded symbols to be represented as any of 16 or 32 different states. See also QAM and Sideband.

QSIG The name under which PSS1 (Private Signaling System number 1), an international standard established by the ISO (International Organization for Standardization) and the IEC (International Electrotechnical Commission). QSIG is a global signaling and control standard for PINX-to-PINX (Private Integrated Network eXchange) applications, intended for use in private corporate ISDN networks to link multiple vendors' PBXs while retaining feature transparency. "Q" comes from the fact that the standard is an extension of the "Q" logical reference point defined by the ITU-T in its Q.93x series of recommendations for generic functions and basic services of ISDN Signaling systems. The early work on QSIG was accomplished by the European Computer Manufacturers Association (ECMA), which built on ITU-T ISDN standards for public networks. As a result, and for obvious reasons, QSIG, therefore, builds on the ITU-T DSS1 (Digital Subscriber Signaling 1) standard. DSS1 defines the logical reference point for ISDN at the user equipment. The impetus for this effort was that of encouraging the harmonization of existing, proprietary private network "standards" toward the reduction of technical trade barriers in the pan-European market. Subsequently, the EC (European Commission) became involved, charging ETSI (European Telecommunications Standards Institute) with the responsibility for further development and promotion of the standard in collaboration with CENELEC (translated from French as European Electrotechnical Standards Committee). QSIG standards are submitted to the JTC1 (Joint Technical Committee 1), which is a collaboration of the ISO (International Standards Organization) and the IEC (International Electrotechnical Commission). The standards also are promoted by the IPNS (ISDN PBX Networking Specification) Forum, which comprises a number of manufacturing companies such as Alcatel, Ascam, Ericsson, Lucent, Nortel, Philips and Siemens.

QSIG is much like the public network DSS1 standard set by the ITU-T, at least at Layers 1 & 2 of the OSI Reference Model. Differences appear at Layer 3, the Network Layer, as QSIG is intended for use in private networks and is symmetrical in nature, with the user side and the network side being identical. Further, QSIG is designed for peer-to-peer operation, although the standard addresses transit node capabilities, as well. QSIG also addresses both connection-oriented and connectionless services, unlike DSS1 standards which address only the former. ECMA currently is working on B-QSIG, which will extend the QSIG protocol stack to B-ISDN (Broadband ISDN). According to the IPNS Forum, QSIG offers user benefits including vendor independence, guaranteed PBX interoperability, free-form network topology, support for an unlimited number of nodes, flexible numbering plan, flexibility of interconnecting

transmission technologies (i.e., analog or digital leased lines, radio and satellite links, and public VPN services). Supplementary services offered by QSIG include name identification, call intrusion, do not disturb, path replacement, operator services, mobility services, and call completion on no reply. As a standards recommendation, QSIG provides manufacturers the freedom to develop custom features, with QSIG providing a standard mechanism for transporting such non-standard features. See also CENELEC, EC, ECMA, ETSI, IEC, ISO, and OSI Reference Model.

QTC Quick Time Conference. Apple Computer's cross-platform, video-conferencing, collaborative computing and multimedia communications technology.

QTVR See Quicktime VR.

quad A slang term for cable conductor with four single, plastic coated, not twisted wires and contained in a single plastic covering. Quad wiring has been traditionally used inside houses and small offices. Since it will not handle data well, it is no longer being recommended for installation anywhere, except in single-line analog (never data) applications. In the old days, a quad wire would support two analog phone lines. Color coding in quad wire in North America is red-green, yellow-black. When I showed this definition to a professional installer, he told me that quad wire was generally not used anymore except by ignorant do-it-yourselfers, cheap telcos (telephone companies), irresponsible contractors, etc. See Quad Wire.

quad-band A mobile (cell) phone that can operate at 850 MHz, 900 MHz, 1800 MHz and 1900 MHz. A quad-band phone can typically operate on any GSM network.

quad block Where "quad" wiring is terminated inside a residence quad block is typically a four screw terminal mounting that has some type of modular plug.

quad cable Cables where four wires are twisted as a unit. High crosstalk may be encountered among the wires within a quad unit.

quad fiber cable A cable consisting of four single optical fiber cables placed inside a polyvinyl chloride jacket with a rip cord to peel back the jacket and gain access to each single cable.

quad inside wire Quad IW. Older phone wire. It has four solid core copper conductors - red, green, black, yellow. Line one colors are green and red, line two colors are yellow and black. Since it's often not twisted, it's susceptible to RFI.

quad LNBF A combination LNBF and multi-sat switch component for DISH 500 systems. Can accommodate up to 4 DISH Network receivers.

quad fiber conduit Conduit that's designed to be buried. The four conduits let companies lease space to each other in a way that's easy to track for fiber-optic cable installers/splicers, etc.

quad shield Two foil, two braid.

quad wire A type of wire which contains four untwisted copper conductors in a plastic sheath. These four conductors are not two separate twisted pairs, although the four may have a very "slow" twist to them. Quad wiring is no longer recommended by the telephone industry for installation in other than analog single line applications. In short, quad is dead. See Quad.

quad VGA QXGA. A new standard for a display resolution, namely 2,048 x 1,536 pixels.

quadded cable A cable in which at least some of the conductors are arranged in the form of a quad.

quadpod An antenna mounting system used for mounting an antenna on a sloped roof.

Quadrature Amplitude Modulation See QAM.

Quadrature Sideband Amplitude Modulation See QAM.

quadruple play When you and I can get four telecommunications services from the same provider, that's called a quadruple play. These four services are broadband Internet, cell phone, fixed line telephone service (either circuit or VoIP) and television. I suspect an ingenious investment banker thought up the idea of quadruple plays in order to convince unsuspecting telecom companies to buy other unsuspecting telecom companies and thus incur huge investment banking fees. See also quintuple play.

quads See Mated Pairs.

Quaero A European multimedia search engine project led by French technology firm Thomson, and announced by French President Jacques Chirac in January 2006. Quaero supporters hope that Quaero will nudge aside Google as the leading search engine in Europe.

QUALDIR QUALification DIRective. A wireless term for changes to a VLR (Visitor Location Register), a database which contains information about legitimate roamers and which describes the features to which they have access. The response to the QUALDIR is a "qualdir" (lower case). See also VLR.

Quality Of Service QoS. Quality of Service is a measure of the telecommunica-

tions—voice, data and/or video—service quality provided to a subscriber. It's not easy to define "quality" of voice telephone service. It's very subjective. Is the call easy to hear? Is it "clear"? Is it loud enough, etc.? The state Public Service Commissions (PSCs) have attempted to define the quality of service they want the residents of their states to have. And they have created various measures to which they insist phone companies conform. They tend to be more measurable. They include the longest time someone should wait after picking up the handset before they receive dial tone (three seconds in most states).

Quality of Service is more easy to define in digital circuits, since you can assign specific error conditions and compare them. For example if you were defining QoS with respect to ATM, it would be defined on an end-to-end basis in terms of the attributes of the end-to-end ATM connection, as detailed in ITU-T Recommendation I.350. The ATM Forum extended this standard through the definition of QoS parameters and reference configurations for the User Network Interface (UNI). ATM Performance Parameters include the following:

- Cell Error Ratio (CER)
- Severely Errored Cell Block Ratio (SECBR)
- Cell Loss Ratio (CLR) Cell Misinsertion Rate (CMR)
- Cell Transfer Delay (CTD)
- Mean Cell Transfer Delay (MCTD)
- Cell Delay Variability (CDV)

ATM Quality of Service (QoS) objectives set by the carriers are defined as Class of Service 1, 2, 3, and 4. Here is an explanation of the various classes: Class 1: Equivalent to digital private lines. Class 2: Supports traffic such as audioconferencing, videoconferencing and multimedia Class 3: Addresses connection-oriented protocols such as SDLC and Frame Relay Class. 4: Supports connectionless data protocols such as SMDS.

In the middle 90s, the concept of carrying voice and video over IP (Internet Protocol) networks suddenly became very important. In a White Paper which Microsoft put out in September 1997, it discussed QoS with the following words:

"What is Quality of Service? In contrast to traditional data traffic, multimedia streams, such as those used in IP Telephony or videoconferencing, may be extremely bandwidth and delay sensitive, imposing unique quality of service (QoS) demands on the underlying networks that carry them. Unfortunately, IP, with a connectionless, "best-effort" delivery model, does not guarantee delivery of packets in order, in a timely manner, or at all. In order to deploy real-time applications over IP networks with an acceptable level of quality, certain bandwidth, latency, and jitter requirements must be guaranteed, and must be met in a fashion that allows multimedia traffic to coexist with traditional data traffic on the same network." For another explanation (this time from Cisco), go to Class of Service.

Qos is full of confusing and sometimes contradictory terms. Here's how Network computing of 9.4.2003 defines them:

Quality of Service: A way to provide better or stable service for select network traffic through bandwidth or latency control.

Saturation Point: The amount of load (packet count, simultaneous sessions or bandwidth utilization) that causes a network device to start dropping an unacceptable percentage packets.

Flow: A session between two hosts (such as a TCP session)> This includes handshaking, data transfer and termination. there can be multiple simultaneous flows between two hosts.

Class: A grouping of flows based on common criteria. May include protocol, source/destination address or subnet.

Classification: Detecting, identifying and potentially marking flows.

Burst Rate vs. Maximum Rate: If a QoS device supports bursting, it can let a class or flow be configured to use more bandwidth than the maximum rate, but only if extra, unused bandwidth is available. Think of it as a second max rate: Burst will always be higher than max rate. If burst equals max rate, then bursting is effectively disabled.

Quantity Above Threshold Indicator QAT: The sum of itemized call minutes that exceeds the minimum threshold of 1500 Minutes of Usage (MOU) that is eligible for a volume discount.

quantity type indicator A Verizon definition. A code that identifies the quantity type for local calling plan charges.

quantization The converting of a native analog signal to digital format through a sampling and quantizing process. This process is accomplished in a CODEC and is necessary in order to send analog data (voice or video) over a digital network (e.g., T-carrier or ATM) or through a digital switch (e.g., PBX or central office).

In the case of a voice signal and using PCM (Pulse Code Modulation), for instance, the amplitude of the native analog signal is sampled 8,000 times per second, with the each sampled amplitude value being expressed as an 8-bit digital value (byte) consisting of a

specific combination of ones and zeros. At the receiving end of the communication, the process is reversed, with the digital value being translated into an analog amplitude value. The result is an approximation of the original analog signal, as it was sampled rather than digitized exactly. Note that the original analog signal varied continuously in terms of both amplitude and frequency. Clearly, the higher the rate of sampling, the truer the reproduced approximate signal; the lower the rate of sampling, the less accurate the reproduced signal. In other words, a low rate of sampling would yield relatively unpleasant voice or fuzzy video as a result of what is known as "quantizing noise." However, a lower rate of sampling requires less bandwidth over the network or through the switch, yielding obvious cost benefits. As is that case with many things in life, there are tradeoffs between cost and quality.

quantization noise Signal errors which result from the process of digitizing (and therefore ascribing finite quantities to) a continuously variable signal. See Quantization.

quantize The process of encoding a PAM signal (Pulse Amplitude Signal) into a PCM signal (Pulse Code Modulation). See Quantization.

quantizing The second stage of pulse code modulation (PCM), for instance. The waveform samples obtained from each communication channel are measured to obtain a discrete value of amplitude. These quantized values are converted to a binary code and transmitted to a distant location to reconstruct an approximation of the original waveform. See Quantize and Quantization.

quantizing noise Noise caused by the inability of an analog signal to be exactly replicated in digital form. Such noise is the result of the fact that the original signal was sampled, yielding an approximation (but not exact replica) of the original signal as it is reconstructed on the receiving end of the communication.

quantum In physics, quantum means a very small indivisible piece of energy. This word is widely misused by people who refer to "a quantum leap," meaning a big leap. See Quantum Computing and Quantum Leap. Also: A time slice, the maximum amount of time a thread can run before the system checks for another ready thread of the same priority to run.

quantum computing A developing computing technology that exploits the properties of atoms to create a radically different type of computer architecture through quantum physics. Quantum computing relies on the basic traits of an atom, such as the direction of its spin (i.e., left-to-right and right-to-left), to create a state, such as a "1" or "0," much as conventional computers use variations in electrical energy (i.e., positive and negative polarity). Further, quantum computing theory suggests that intermediate states can be created. Further, the entanglement of spins between atoms can enable them to function as a collective whole. Qubits (quantum bits), therefore, are more than binary "1" and "0" bits. Qubits speak paragraphs, rather than bits of letters that make up words that make up sentences that make up paragraphs. This concept shatters the bounds of binary logic, linear processing, and computing speed. Don't look for it next week, or next month, or next year. Tell your grandchildren to look for it. Tell them to buy a copy of this book, which by then will be written by my grandchildren and will be in at least its 100th edition. But then, quantum publishing may have rendered the printed word to be obsolete, and they may be reading this book by watching atoms rotate. See Quantum and Quantum Leap.

Quantum Flow Control An ATM term. See QFC.

quantum leap In physics, quantum means a very small parcel or increment of energy. Also in physics, quantum leap or quantum jump refers to the abrupt transition (of something such as an electron, atom or molecule) from one discrete energy level to another. In popular usage, the term refers to an abrupt change, dramatic advance, or sudden increase. For instance, it might be said that major system enhancements which entail "forklift upgrades" involve quantum leaps in cost. Systems which are scalable do not. See also Forklift Upgrade and Scalable.

quantum mirage effect This process uses quantum waves to transfer information from one part of a nanoprocessor to another without relying on any physical connections.

quark Physicist Murray Gell-Mann named the sub-atomic particles known as quarks for a random line in James Joyce, "Three quarks for Muster Mark!"

QuarkXpress Probably the best typesetting and layout program around for the PC and for the Mac. Adobe is trying to compete with InDesign.

quarter speed An international leased teletype line capable of transmitting one quarter of Telex speed of 16 2/3 words per minute.

quarter wave antenna An antenna, the length of which is 1/4 that of the wave length received.

quartz Code-name for a tablet-like, quarter-VGA portrait screen size, pen-based, reference design, typically used in cell phones or PDAs. See also Quartz Crystal.

quartz crystal A small piece of quartz which is cut to a precise size. When electricity